PATENT ABSTRACTS OF JAPAN

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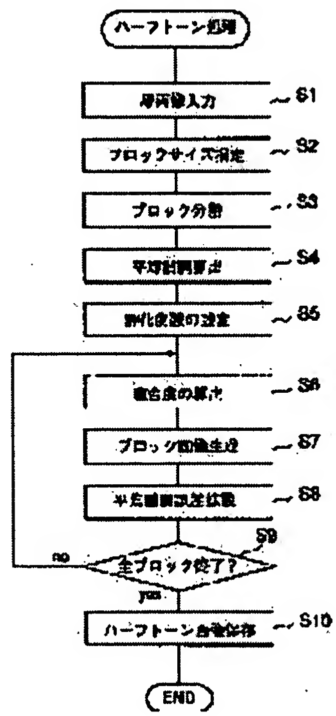
(54) HALF TONE PROCESSOR, AND MEDIUM HAVING STORED ITS PROCEDURE

(57)Abstract:



PROBLEM TO BE SOLVED: To provide a half tone processor which can get a high-quality half tone image high in reproducibility, and can finish the processing in a short time, and a medium having recorded its procedure.

SOLUTION: These are a half tone processor consisting of a block dividing means, which divides a input image into blocks consisting of specified size of picture elements, an adaptation computing means which makes the picture element of each block a vector and compares this with a code word to serve as a candidate of conversion and computes the adaptation, an image generating means which generates an image in the block, based on the code word where the adaptation is maximum, an error diffusing means which diffuses the average stratum error of the block to the neighboring block of a block being processed thereafter, and a storage medium having recorded its procedure.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention belongs to the technical field which processes image data by computer. It is related with the half toning which generates a halftone image (false shade image) from a shade image especially.
[0002]
[Description of the Prior Art] Half toning is the processing which can be made to perform a near expression with an original shade image (full tone image) exceeding the limit in the reappearance system which has a limit theoretically in the number of gradation which can be expressed. For example, in offset printing, ink reproduces an image theoretically only in two parts of the part of the halftone dot impressed on a print sheet, and the part of the form itself which is not impressed. In color printing, an image is reproduced only by 16 colors with the combination of the printing pile of the halftone dot and halftone dot of four colors of CMYK (cyan, magenta, yellow, black).
[0003] As everyone knows, in order to exceed such a limit in offset printing, changing halftone dot % is performed. Halftone dot % is the ratio of the area which a halftone dot occupies in a printing side. Since this halftone dot is detailed, if it sees from the distant view (about 20cm or more) which is extent that fine structure is not in sight, it will be recognized as neutral colors with a visual property, and a full color full tone image will be reproduced in false.
[0004]
[Problem(s) to be Solved by the Invention] A contact screen is conventionally used for processing which generates this halftone dot in offset printing. That is, the film of a halftone dot image has been obtained by carrying out adhesion exposure and developing the film of a contact screen and a subject-copy image to a sensitive film, in piles. Since a contact screen is a periodic image, it also arranges periodically the halftone dot in this halftone dot image (refer to drawing 7 (A)).
[0005] If this periodic halftone dot is printed and piled up in color printing, it will become

the cause of generating moire. In each color, the screen include angle is changed from the need of avoiding this, in practice. However, even if generating of moire is avoidable, the hexagonal pattern (rosette pattern) to which it is a failure on vision and printing quality is reduced cannot remain, and the generating cannot be avoided to coincidence (refer to drawing 6).

[0006] It is recognized as a cause being for the detailed dot which constitutes a halftone dot concentrating generating of this hexagonal pattern on that periodic part with a halftone dot being periodic. Then, a halftone dot is made into distributed process input output equipment, or making it aperiodic is proposed. This is because it became possible for recent years to come and to generate the dot of arbitration by computer processing.

[0007] The base of the processing is the comparison operation of a subject-copy image and the threshold matrix (dither matrix) of predetermined size. As this approach, although the fixed-mask-of-illuminator method, the systematic dither method, the random dither method, etc. are known, since a threshold matrix is regularly arranged in a whole image, it has the problem that periodicity cannot be eliminated (refer to drawing 7 (B)).

[0008] Although application of addition processing of enlargement of ** block size, application of a threshold matrix ** Different and the dither value over ** subject-copy image, a random number, and a blue noise etc. is proposed in order to reduce recognition of this periodicity, periodicity is recognized too (refer to drawing 8 (D)).

[0009] as the approach which is not based on a comparison operation with a threshold matrix -- the average error minimum method and error diffusion (ED) -- law etc. is known. In order to aim at reduction of a quantizing noise with the advantage that there is no periodicity, it excels in the shelf life of average gradation, or the repeatability of details. However, there is a problem of generating survival of a granular feeling, change of a gradation property, and the texture of the shape of a peculiar worm (refer to drawing 8 (C)). Moreover, there is a problem that the load of data processing needs the suitable large processing time by the increment in the amount of operations.

[0010] This invention is made in order to solve the above-mentioned problem. The purpose can obtain the halftone image of high quality with high repeatability, and is to offer the medium which recorded the half toning equipment which can moreover finish the processing in a short time, and its procedure.

[0011]

[Means for Solving the Problem] The above-mentioned technical problem is solved by following this invention. Namely, the half toning equipment concerning claim 1 of this invention It is halftoning equipment which derives the image which has the pixel value of N bit expression which is M>N from the image which has the pixel value of a M bit expression by making L, M, and N into a positive integer. A block division means, It has a goodness of fit calculation means, an image generation means, and an error diffusion

means. Said block division means An input image is divided into the block which consists of a pixel of the predetermined size L. Said goodness of fit calculation means Make the pixel of said divided block into L-dimensional a M-bit vector, and a goodness of fit is computed as compared with the codeword of the L-dimensional N bit which serves as a conversion candidate in this. Said image generation means generates the image of a L-dimensional N bit to said block based on the codeword of max [goodness of fit], and said error diffusion means is made to carry out error diffusion to the near block of said block which processes the average gradation error of said block henceforth.

"max. Likelihood"?

[0012] According to this invention, it is divided into the block by which an input image consists of a pixel of the predetermined size L with a block division means. The pixel of the block is made into L-dimensional the vector it is [vector] M bits by the goodness of fit calculation means. As compared with the codeword of the L-dimensional N bit which serves as a conversion candidate, a goodness of fit is computed in this. Based on the codeword of max [goodness of fit], the image of a L-dimensional N bit is generated by the block with an image generation means, and error diffusion is carried out to the near block of the block which processes the average gradation error of the block with an error diffusion means henceforth. That is, since a goodness of fit is based on the greatest codeword, the image generated by block can obtain the image optimized in the whole halftone image. Moreover, since error diffusion is performed, the image is excellent in the tone reproduction. Therefore, the half toning equipment with which the halftone image of high quality with high repeatability is obtained is offered.

[0013] Moreover, in the half toning equipment which the half toning equipment concerning claim 2 of this invention requires for claim 1, it is made to perform said error diffusion which said error diffusion means performs by offsetting the error in the process which computes the average gradation error of said block. According to this invention, since the error is offset in the process which computes an average gradation error, the load of the processing in error diffusion is very small.

[0014] Moreover, the half toning equipment concerning claim 3 of this invention makes J and K a positive integer in the half toning equipment concerning claims 1 or 2, and said block division means divides an input image into the block of the rectangle which consists of a pixel of JxK=L which is predetermined size. according to this invention, processing carries out with a rectangular block -- having -- the fundamental and briefest **** -- being certain -- ** -- the repeatability of a horizontal line and a vertical line is [both] excellent.

[0015] Moreover, said block division means is divided into the block of the hexagon or triangle which consists an input image of a pixel of the predetermined size L, or the tiling (tiling) form which combined them in the half toning equipment which the half toning equipment concerning claim 4 of this invention requires for either of claims 1-3. According to this invention, recognition of periodicity is eased and the repeatability by the direction is

equated.

[0016] Moreover, it is made for the half toning equipment concerning claim 5 of this invention to have an optimization parameter setup means to set up the optimization parameter for computing a goodness of fit, in the half toning equipment concerning either of claims 1-4. According to this invention, since calculation of a goodness of fit is rationalized by setting up an optimization parameter, a more nearly quality halftone image with more high repeatability is obtained.

[0017] Moreover, it is made for the half toning equipment concerning claim 6 of this invention to have a code book storage means to memorize the code book with which the codeword of the L-dimensional N bit generated beforehand was indicated, in the half toning equipment concerning either of claims 1-5. According to this invention, the thing of the code book with which the codeword was generated beforehand is applied. Therefore, in half toning, the processing time is shortened only for the time amount of a codeword operation. Moreover, since beforehand proper **** can be performed about the number of codewords, the processing time is shortened further.

[0018] Moreover, it is made for the half toning equipment concerning claim 7 of this invention to have a codeword serial generation means to generate the codeword of a L-dimensional N bit serially, in the half toning equipment concerning either of claims 1-5. According to this invention, the codeword which suited the condition of half toning can be generated and the processing concerning an unnecessary codeword is omitted.

[0019] Moreover, in the half toning equipment which the half toning equipment concerning claim 8 of this invention requires for either of claims 1-7, the codeword of said L-dimensional N bit is made to make the total under 2^L (Lth power of 2). According to this invention, half toning is accelerated.

[0020] Moreover, in the half toning equipment concerning either of claims 1-8, the half toning equipment concerning claim 9 of this invention possesses two or more processing sections, and the half toning equipment assigns the block which said block division means divided to each of two or more of said processing sections, and it is made to carry out parallel distributed processing by said two or more processing sections. According to this invention, half toning is accelerated.

[0021] Moreover, the half toning equipment concerning claim 10 of this invention is made to carry out parallel distributed processing of the calculation of said goodness of fit which said goodness of fit calculation means performs by said two or more processing sections in the half toning equipment concerning claim 9. According to this invention, half toning is accelerated.

[0022] Moreover, in the half toning equipment which the half toning equipment concerning claim 11 of this invention requires for either of claims 1-10, calculation of the goodness of fit by said goodness of fit calculation means does not all search for said codeword, but a

goodness of fit searches for the greatest codeword by the optimization technique. According to this invention, half toning is accelerated remarkably.

[0023] Moreover, in the half toning equipment which the half toning equipment concerning claim 12 of this invention requires for either of claims 1-11, said image is P color image considering P as two or more integers, and the pixel of said block is processed as a vector of M bits (LxP) of dimensions. According to this invention, half toning for a multi-colored picture image is performed.

[0024] Moreover, in the half toning equipment which the half toning equipment concerning claim 13 of this invention requires for either of claims 1-11, said image is a multi-colored picture image, and is made to perform said processing for every color image of the multi-colored picture image. According to this invention, the half toning for a multi-colored picture image is accelerated.

[0025] Moreover, the half toning equipment concerning claim 14 of this invention is made to carry out parallel distributed processing of the processing for said every color image by said two or more processing sections for said every color image in the half toning equipment concerning claim 13. According to this invention, the half toning for a multi-colored picture image is accelerated remarkably.

[0026] Moreover, the medium by which the half toning procedure concerning claim 15 of this invention was recorded From the image which has the pixel value of a M bit expression by making L, M, and N into a positive integer It is the medium by which the half toning procedure which derives the image which has the pixel value of N bit expression which is M>N was recorded. Said half toning procedure Have a block division process, a goodness of fit calculation process, and an image generation process, and it sets in said block division process. Divide an input image into the block which consists of a pixel of the predetermined size L, and it sets in said goodness of fit calculation process. Make the pixel of said divided block into L-dimensional a M-bit vector, compute a goodness of fit as compared with the codeword of the L-dimensional N bit which serves as a conversion candidate in this, and it sets in said image reconstruction process [redacted]

[0027] According to this invention, it is divided into the block with which an input image consists of a pixel of the predetermined size L in a block division process. The pixel of the block is made into L-dimensional the vector it is [vector] M bits in a goodness of fit calculation process. A goodness of fit is computed as compared with the codeword of the L-dimensional N bit which serves as a conversion candidate in this, and the image of a L-dimensional N bit is generated by the block based on the codeword of max [goodness of

fit] in an image generation means. That is, since a goodness of fit is based on the greatest codeword, the image generated by block can obtain the image optimized in the whole halftone image. Moreover, since error diffusion is performed, the image is excellent in the tone reproduction. Therefore, the medium which recorded the procedure of half toning with which the halftone image of high quality with high repeatability is obtained is offered.

[0028]

[Embodiment of the Invention] Next, the gestalt of operation is explained about this invention. This invention makes simple error diffusion a basic technique. Furthermore, this invention adds and extends error diffusion to basic techniques, such as vector quantization and optimization. Therefore, it essentially differs from the conventional approach of making threshold processing etc. a basic technique.

[0029] First, the error diffusion technique is explained briefly. For example, a [redacted] carrying out halftone imaging of the subject-copy image of the full tone of standard 8-12-bit gradation, gradation expression capacity is insufficient. This gradation expression capacity can supplement with lack with an error diffusion technique.

[0030] An explanatory view is shown in drawing 3 about error diffusion process. When a subject-copy image is made into 8-bit gradation, the pixel value has the value of 0-255. When a halftone image is made into 1-bit gradation, the pixel value has the value of 0 or 255 (good also as 0 or 1). In drawing 3 , the pixel value inputted into the inlet port of a quantizer is changed into 0 or 255 in a quantizer, and is outputted to the outlet of a quantizer. For example, conversion which sets 127 or less to 0 and sets 128 or more to 255 is performed. The changed pixel value is further outputted to an output side from the outlet of a quantizer. This changed pixel value is a pixel value of a halftone image.

[0031] By quantization in this quantizer, since the value of 0-255 is rounded off by the value of 0 or 255, an error (quantization error) will be produced between the value of a basis, and the value after quantization. As shown in drawing 3 , the pixel value inputted into the inlet port of a quantizer is subtracted by the pixel value (changed pixel value) outputted to the outlet of a quantizer. That is, a quantization error calculates. This quantization error is inputted into the inlet port of a filter.

[0032] The role which determines how a filter diffuses an error is played. The simplest diffusion approach is the approach of performing simple delay and adding to the following pixel. in addition -- ** -- [redacted] s for many, the scan of a subject-copy image also has the approach of distributing to two or more pixels the right in the pixel which calculated the quantization error in that case, and down.

[0033] In drawing 3 , a subject-copy image is scanned from an input side, and the

sequential input of the pixel value is carried out. A quantization error is added to the pixel value. [redacted] and it [redacted] process of a series of. Consequently, the halftone image which is comparatively excellent in the repeatability of details and the repeatability of average gradation can be obtained.

[0034] In ****, the error diffusion in the formation of a scalar quantity child which is expressed for one numeric value and which is quantized for every pixel was explained. The same is fundamentally said of the error diffusion in vector quantization. As what is mentioned later, the explanation about what error diffusion is applied for in the process of the vector quantization of an image explains vector quantization briefly here. General quantization, i.e., the formation of a scalar quantity child, rounds off continuation or a discontinuous scalar value (value of a single dimension) to a discrete scalar value (quantization central value). For example, actuation of rounding off below decimal point and obtaining an integral value is scalar quantization. [redacted] alue, [redacted].

[0035] On the other hand, vector quantization is developed into a vector value (value of many dimensions). Quantization central value is divided into the BORONOI polygon (polygon of many dimensions) made into a generatrix, and all the vector values included in the polygon round off the space where vector quantization is stretched by the vector to the quantization central value which is the generatrix of the polygon.

[0036] The example of rounding off in a scalar value and the example of the quantization in the easiest two-dimensional vector value are shown in drawing 4 . Drawing 4 (A) shows the case of a scalar value, and drawing 4 (B) shows the case of a vector value. The sunspot (black dot) expresses in drawing 4 , the generatrix, i.e., the quantization central value, of a BORONOI polygon. Quantization is processing which rounds off the scalar value or vector value in the field surrounded by each boundary line to the quantization central value expressed with the sunspot.

[0037] In drawing 4 , each boundary line is perpendicular 2 bisectrix of a segment which connects an adjoining sunspot, and is the set of an equal distance point. Even if a boundary line equivalent to drawing 4 is the Euclidean space of what kind of dimension, it exists. When quantization central value is a vector, quantization central value is also called a quantization central value vector. The quantization central value vector by which a specific vector value is rounded off among a large number quantization central value vectors is a quantization central value vector by the side of recently [of the vector value] so that clearly also from drawing 4 .

[0038] That is, a specific vector value is rounded off by the quantization central value

vector from which Euclidean distance serves as min. Numerically, a quantization central value vector is chosen so that the square sum of the difference of the corresponding element in two vectors may serve as min. Here, a quantization central value vector is called a codeword and the set is called a code book.

[0039] In addition, in this invention, a subject-copy image presupposes that the halftone image which it is going to obtain is a binary (1 bit) image by the image which has the gradation of 256 values (8 bits). If a vector is two-dimensional (2-pixel unit) at this time, a quantization central value vector will serve as 4 and the cage of ((0, 0), (0,255), (255, 0), 255,255). It will become 16 and a cage if a vector is four dimensions (4-pixel unit). A quantization central value vector in case a vector is four dimensions is shown in drawing 5 . In drawing 5 , when a white rectangle is set to "0" and a black rectangle is set to "255", average gradation is 0, 64, 64, 128, 64, 128, 128, 191, 64, 128, 128, 191, and 128,191,191,255 (rounding off) in order from the upper left, and each gradation is 1, 4, 6, and 4 or 1 every passage in order of gradation (it becomes a binomial coefficient).

[0040] Next, about the half toning in this invention, an example is given and a processing process is explained. The half toning which derives the image (halftone image) which has the pixel value of an N= 1-bit (2) gradation expression from the image (subject-copy image) which has the pixel value of an M= 8-bit (256) gradation expression is explained. Although it is natural, the concrete numeric value in the processing to be explained from now on can show an example, and can choose a numeric value which is different from explanation so that it may suit in each case in concrete operation of this invention. An image may be a multi-colored picture image and the size of an image, the size of a block, and the number of gradation of a subject-copy image may differ from the number of gradation of a halftone image.

[0041] An example of the processing process in the half toning equipment of this invention is shown in drawing 1 . First, a subject-copy image is inputted into the storage section of half toning equipment in step S1 of drawing 1 . A subject-copy image shall be a 1024x1024=1048576 pixel shade image. Next, the size of a predetermined block is specified in step S2. The size of a block of 4 pixel x4 pixel is specified as an example.

[0042] Next, a subject-copy image is divided into the block of 4 pixel x4 pixel in step S3. That is, it is J=K=4 and L=4x4=16. Since a subject-copy image is a 1024x1024-pixel shade image, it is divided into the block of 256x256=65536. This block can be expressed as a 16-dimensional vector. It processes to the 65536 16-dimensional vector after this. The explanatory view of the division into the block from a subject-copy image and the relation of a 16-dimensional vector is shown in drawing 2 . Drawing 2 (A) is a subject-copy image, and drawing 2 (B) is a block.

[0043] In addition, suppose that it supposes that a raster scan is carried out to the lower right from the upper left of a square block since the order of [illegible] of the element (pixel

value) of the 16-dimensional vector in **** is easy, and the raster scan also of the order of processing of a [redacted]

[0044] Next, in step S4, the arithmetic mean of the element is searched for for every vector. That is, it asks for the average gradation of each vector. Generally, although the arithmetic mean becomes nonintegral, since it is easy, it can be rounded off to an integral value. In that case, the number of gradation in the average gradation of each vector is in agreement with the M= 8-bit (256) gradation expression of a subject-copy image. Of course, the processing time can also be processed, without rounding off, although it becomes long.

[0045] Next, in step S5, the performance index for judging a goodness of fit is set up. In the vector quantization mentioned above, it will be judged with the codeword (quantization central value vector) which makes Euclidean distance min conforming most, and the codeword will be chosen. Here, since it aims at deriving a halftone image, a factor called the average gradation obtained in step S4 is taken into consideration.

[0046] For example, a performance index is set up like following several 1.

[Equation 1]

F(Gi, Ho) =alphax|deltaD|+ betaxdelta Q/L, however F (Gi, Ho) ; Performance index Gi ; Vector of a subject-copy image (block of a subject-copy image)

Ho ; Codewords alpha and beta ; Multiplier (alpha+beta = 1, 0<=alpha, beta<=1)

| deltaD|; Error of average gradation (|x| expresses the absolute value of x)

deltaQ ; Error L of vector quantization ; Number of dimension (16)

[0047] Next, a goodness of fit is computed in step S6. A goodness of fit is given by the performance index shown in several 1. In the performance index shown in several 1, a goodness of fit will be high, so that the value of a performance index is small. Therefore, I hear that computing a goodness of fit searches for Hj which a performance index makes min for every Gi, and there is. One by one, a codeword is generated (16th power passage of 2) and it all searches for what minimizes the performance index F shown in several 1.

[0048] here -- suffix o -- 0<=o<2^16 (16th power of 2) -- it is a number. That is, it is the total of a codeword. Moreover, suffix i is a becoming number 0 <=i<65536. That is, it is the ordinal number of the 16-dimensional vector (block) in a subject-copy image. 0 <=j<16=L Moreover, suffix j is a becoming number. That is, it is a number showing the sequence of each element of a vector.

[0049] Next, in step S7, a goodness of fit generates the image of a L-dimensional N bit to the block which corresponds based on the greatest codeword. Thus, by processing the specific 16-dimensional vector (block) in a subject-copy image, the part of the block of the image of a L-dimensional N bit, i.e., a halftone image, is generated by the block.

[0050] Next, in step S8, a goodness of fit calculates, the difference, i.e., the average gradation error, of the average gradation of the greatest codeword, and the average

gradation of the 16-dimensional vector (block) in a subject-copy image, and carries out error diffusion to the block processed henceforth. The error diffusion in here is error diffusion in vector quantization.

[0051] Here, it explains applying error diffusion in the process of the vector quantization of an image [redacted] Or when computing an average gradation error, it can carry out by amending according to Error p.

[0052] Specifically, amendment when computing the average gradation error can be performed by amending the value of |deltaD| which is an average gradation error in the performance index shown in several 1 according to Error p. The performance index in the case of applying error diffusion in the process of the vector quantization of this image becomes like following several 2.

[Equation 2]

F(Gi, Ho) =alphax|deltaD-p|+ betaxdelta Q/L, however F (Gi, Ho) ; Performance index Gi ; Vector of a subject-copy image (block of a subject-copy image)

Ho ; Codewords alpha and beta ; Multiplier (alpha+beta = 1, 0<=alpha, beta<=1)

| deltaD|; Error of average gradation (|x| expresses the absolute value of x)

p ; Error deltaQ of the average gradation in a former block ; Error L of vector quantization ; Number of dimension (16)

[0053] Next, in step S8, it is judged whether processing of step S6 and step S7 was performed to all blocks. When the processing has ended to no blocks, the step after return is repeated to step S6. When the processing has ended to all blocks, it progresses to step S9. Next, the generated halftone image is saved in step S9.

[0054] In the above, based on <u>drawing 1</u> , an example was explained about the half toning in this invention. Next, the modification is explained. In the performance index shown in the above-mentioned several 1 and several 2, since front term |deltaD| and |deltaD-p| are the errors of average gradation, they express the repeatability of a rough shade. Moreover, since next term deltaQ/L is RMSE (root mean square error), it expresses the repeatability of the fine structure. Therefore, if alpha is enlarged, reappearance of the fine structure will fall victim instead of a shade being reproduced good. Conversely, if beta is enlarged, reappearance of a shade will fall victim instead of the fine structure being reproduced good. Then, it is suitable, if it constitutes so that calculation of a goodness of fit may be optimized, and alpha and beta as a parameter (parameter) for giving a load by the directions input can be set as any value. It is referred to as alpha=beta =0.5, in order to see synthetically and to enable it to obtain good reappearance.

[0055] In addition, the performance index in this invention is not limited to the performance index shown in several 1. In the performance index shown in several 1, although average gradation was taken into consideration, the continuity of dot gain or a dot can also be taken into consideration.

[0056] Moreover, the subject-copy [redacted] Moreover, as long as it can essentially be filled up with a flat surface (false), a hexagon and a triangle (false) are sufficient. Furthermore, tiling which combined them by turns (tiling).

[0057] Moreover, in explanation of the above-mentioned step S6, although it explained performing all retrieval as an example, calculation of the goodness of fit in this invention is not limited to all retrieval. For example, optimization techniques, such as a heredity algorithm (GA;genetic algorithm), are applicable.

[0058] Moreover, in order to shorten the processing time by all retrieval, it is accelerable by using much processing sections (CPU;central processor unit etc.), and carrying out parallel distributed processing of the comparison with two or more codewords. Moreover, a partial image is set as a subject-copy image, and for every partial image of the, a block can be assigned to each of two or more processing sections, and it can accelerate by carrying out parallel distributed processing using two or more processing sections. Moreover, in each item of a performance index, the above-mentioned several 1 [i.e.,], it is accelerable by carrying out parallel distributed processing of the term of alphax|deltaD|, and the term of betaxdelta Q/L using the respectively different processing section.

[0059] Moreover, processing is accelerable by closing the operation of a performance index on the way conditionally. For example, when are asked for alphax|deltaD| and it becomes a bigger value than the minimum value calculated by then, since it cannot become the minimum value clearly, you may move to the next evaluation.

[0060] Moreover, this actuation can be simplified, if the average gradation value of a codeword is calculated beforehand and it arranges according to that sequence. Moreover, in explanation of the above-mentioned step S6, although explanation which generates a codeword serially was performed, if the codeword is generated beforehand, and it is made to memorize as a code book with the average gradation value and processes with reference to the code book, processing is accelerated and it is suitable.

[0061] Moreover, in an example shown in drawing 1, it explained as if the subject-copy image was a monochrome image. What is necessary is just to make a vector connect in order of the order of an array of a pixel, or a multicolor plane (layer), when treating a multi-colored picture image similarly. For example, when a subject-copy image is P color image considering P as two or more integers, the pixel of a block will be processed as a

vector of a dimension (16xP).

[0062] Of course, the above-mentioned processing can be performed to each of each color image in a multi-colored picture image instead of connecting a vector. In that case, it can set and processing can be accelerated by carrying out parallel distributed processing of the processing to each of each color image by two or more processing sections.

[0063] In the above, the gestalt of operation explained this invention. Then, it explained at focusing on the processing in half toning equipment. However, this invention is not limited to half toning equipment. Though natural, the medium by which the procedure was recorded is also contained.

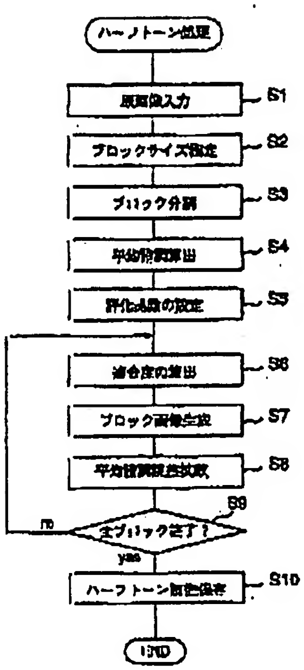
[0064]

[Effect of the Invention] Since it is as above, according to the half toning equipment concerning claim 1 of this invention, the half toning equipment which can obtain the halftone image of high quality with high repeatability is offered. Moreover, according to the half toning equipment concerning claim 2 of this invention, the error is offset in the process which computes an average gradation error, and the load of the processing in error diffusion can be made very small. Moreover, according to the half toning equipment concerning claim 3 of this invention, while being the fundamental and briefest processing, the repeatability of a horizontal line and a vertical line is excellent. Moreover, according to the half toning equipment concerning claim 4 of this invention, recognition of periodicity is eased and the repeatability by the direction is equated. Moreover, according to the half toning equipment concerning claim 5 of this invention, a more nearly quality halftone image with more high repeatability can be obtained. Moreover, according to the half toning equipment concerning claim 6 of this invention, the processing time accompanying a codeword operation can be shortened and the processing time can be further shortened by proper **** of the number of codewords. Moreover, according to the half toning equipment concerning claim 7 of this invention, according to a situation, the processing concerning an unnecessary codeword is omissible. Moreover, according to the half toning equipment concerning claim 8 of this invention, half toning is accelerable. Moreover, according to the half toning equipment concerning claim 9 of this invention, half toning is accelerable. Moreover, according to the half toning equipment concerning claim 10 of this invention, half toning is remarkably accelerable. Moreover, according to the half toning equipment concerning claim 11 of this invention, half toning is accelerable. Moreover, according to the half toning equipment concerning claim 12 of this invention, half toning for a multi-colored picture image can be performed. Moreover, according to the half toning equipment concerning claim 13 of this invention, the half toning for a multi-colored picture image is accelerable. Moreover, according to the half toning equipment concerning claim 14 of this invention, the half toning for a multi-colored picture image is remarkably accelerable. Moreover, according to the medium by which the half toning procedure

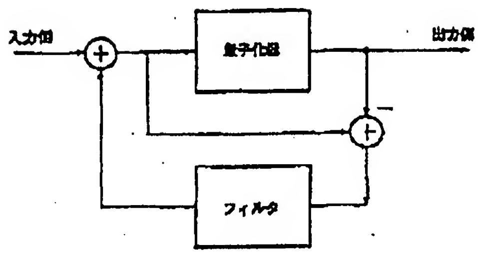
concerning claim 15 of this invention was recorded, the medium which recorded the procedure of the half toning which can obtain the halftone image of high quality with high repeatability is offered.

[Translation done.]

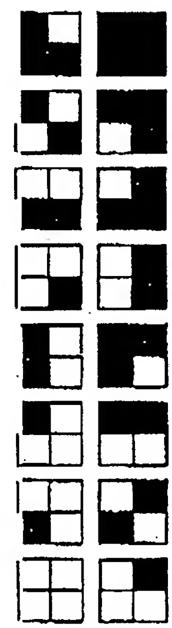
【図1】



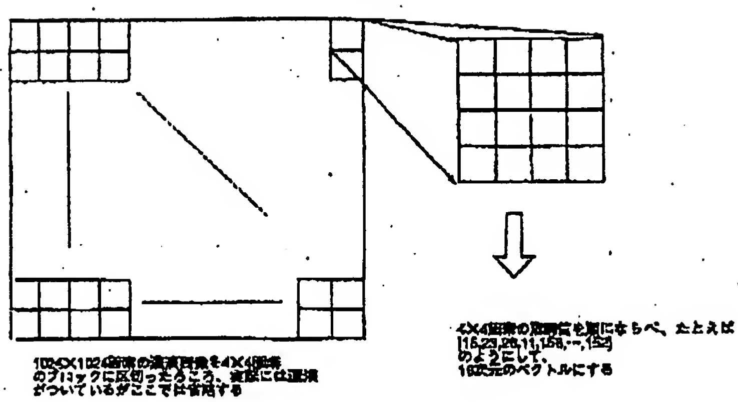
【図3】



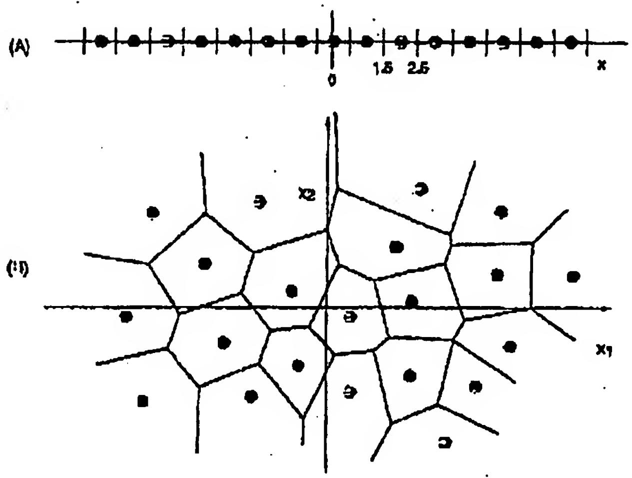
【図5】



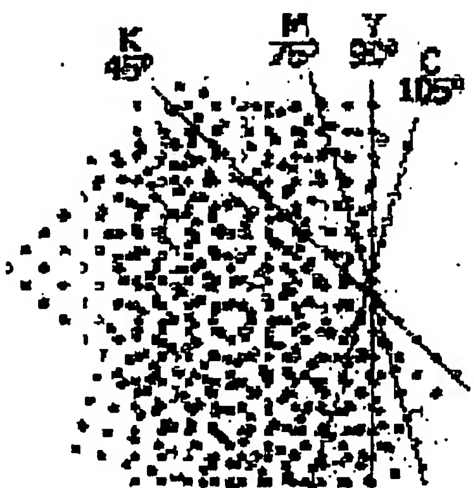
【図2】



【図4】



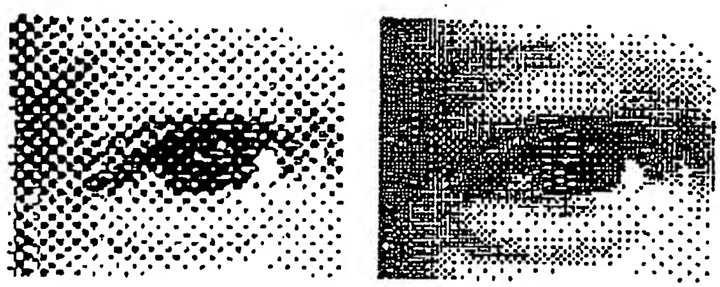
【図6】



Traditional Screen Angles

【図7】

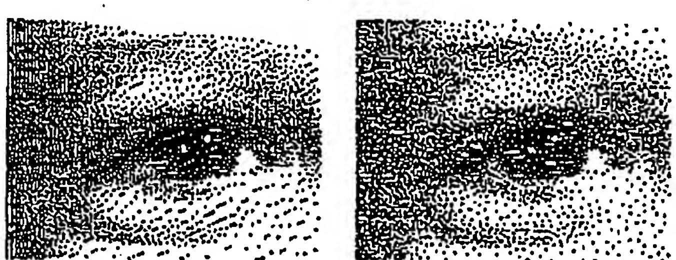
(A) (B)



周期的集中網点　周期的分散網点

【図8】

(C) (D)



誤差拡散法　ブルーノイズマスク法

ワーム

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing an example of the processing process in the half toning equipment of this invention.
[Drawing 2] It is the explanatory view of the division into the block from a subject-copy image, and the relation of a 16-dimensional vector.
[Drawing 3] It is an explanatory view about error diffusion process.
[Drawing 4] It is drawing showing the example of rounding off in a scalar value, and the example of the quantization in the easiest two-dimensional vector value.
[Drawing 5] It is drawing showing a quantization central value vector in case a vector is four dimensions.
[Drawing 6] It is drawing showing the hexagonal pattern (rosette pattern) generated when printing and piling up a periodic halftone dot.
[Drawing 7] It is drawing showing an example (image according [accord / A / a contact screen / B] to a periodic distribution halftone dot) of a halftone image.
[Drawing 8] It is drawing showing an example (image according [accord / C / an error diffusion method / D] to the blue noise mask method) of a halftone image.

[Translation done.]